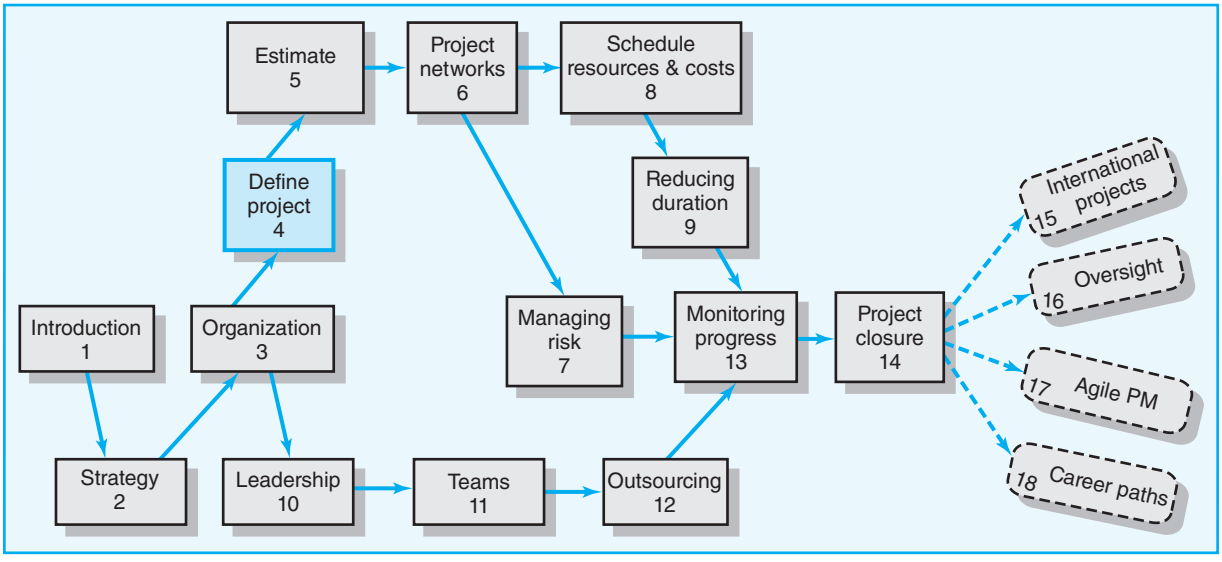
CHAPTER FOUR

Defining the Project



***S**elect a dream*
***U**se your dream to set a goal*
***C**reate a plan*
***C**onsider resources*
***E**nhance skills and abilities*
***S**pend time wisely*
***S**tart! Get organized and go*

. . . it is one of those acro-whatevers,
*said Pooh.**

Project managers in charge of a single small project can plan and schedule the project tasks without much formal planning and information. However, when the project manager must manage several small projects or a large complex project, a threshold is quickly reached in which the project manager can no longer cope with the detail.

This chapter describes a disciplined, structured method for selectively collecting information to use through all phases of the project life cycle, to meet the needs of all stakeholders (e.g., customer, project manager), and to measure performance against the strategic plan of the organization. The method suggested is a selective outline of the project called the *work breakdown structure*. The early stages of developing the outline serve to ensure that all tasks are identified and that participants of the project have an understanding of what is to be done. Once the outline and its detail are defined, an integrated information system can be developed to schedule work and allocate budgets. This baseline information is later used for control.

In addition, the chapter presents a variant of the work breakdown structure called the *process breakdown structure* as well as responsibility matrices that are used for smaller, less complex projects. With the work of the project defined through the *work breakdown structure,* the chapter concludes with the process of creating a communication plan used to help coordinate project activities and follow progress.

The five generic steps described herein provide a structured approach for collecting the project information necessary for developing a work breakdown structure. These steps and the development of project networks found in the next chapters all take place concurrently, and several iterations are typically required to develop dates and budgets that can be used to manage the project. The old saying "We can control only what we have planned" is true; therefore, defining the project is the first step.

* Roger E. Allen and Stephen D. Allen, *Winnie-the-Pooh on Success* (New York: Penguin, 1997), p. 10.

Step 1: Defining the Project Scope

Defining the project scope sets the stage for developing a project plan. Project scope is a definition of the end result or mission of your project—a product or service for your client/customer. The primary purpose is to define as clearly as possible the deliverable(s) for the end user and to focus project plans. As fundamental and essential as scope definition appears, it is frequently overlooked by project leaders of well-managed, large corporations.

Research clearly shows that a poorly defined scope or mission is the most frequently mentioned barrier to project success. In a study involving more than 1,400 project managers in the United States and Canada, Gobeli and Larson (1986) found that approximately 50 percent of the planning problems relate to unclear definition of scope and goals. This and other studies suggest a strong correlation between project success and clear scope definition (cf., Ashley et al., 1987; Pinto and Slevin, 1988; Standish Group, 2009). The scope document directs focus on the project purpose throughout the life of the project for the customer and project participants.

The scope should be developed under the direction of the project manager, customer, and other significant stakeholders. The project manager is responsible for seeing that there is agreement with the owner on project objectives, deliverables at each stage of the project, technical requirements, and so forth. For example, a deliverable in the early stage might be specifications; for the second stage, three prototypes for production; for the third, a sufficient quantity to introduce to market; and finally, marketing promotion and training.

Your project scope definition is a document that will be published and used by the project owner and project participants for planning and measuring project success. *Scope* describes what you expect to deliver to your customer when the project is complete. Your project scope should define the results to be achieved in specific, tangible, and measurable terms.

Employing a Project Scope Checklist

Clearly, project scope is the keystone interlocking all elements of a project plan. To ensure that scope definition is complete, you may wish to use the following checklist:

Project Scope Checklist

1. Project objective
2. Deliverables
3. Milestones
4. Technical requirements
5. Limits and exclusions
6. Reviews with customer

1. **Project objective.** The first step of project scope definition is to define the overall objective to meet your customer's need(s). For example, as a result of extensive market research a computer software company decides to develop a program that automatically translates verbal sentences in English to Russian. The project should be completed within three years at a cost not to exceed

$1.5 million. Another example is to design and produce a completely portable, hazardous waste, thermal treatment system in 13 months at a cost not to exceed $13 million. The project objective answers the questions of what, when, and how much.

2. **Deliverables.** The next step is to define major deliverables—the expected, measurable outputs over the life of the project. For example, deliverables in the early design phase of a project might be a list of specifications. In the second phase deliverables could be software coding and a technical manual. The next phase could be the prototype. The final phase could be final tests and approved software. Note: Deliverables and requirements are often used interchangeably.
3. **Milestones.** A milestone is a significant event in a project that occurs at a point in time. The milestone schedule shows only major segments of work; it represents first, rough-cut estimates of time, cost, and resources for the project. The milestone schedule is built using the deliverables as a platform to identify major segments of work and an end date—for example, testing complete and finished by July 1 of the same year. Milestones should be natural, important control points in the project. Milestones should be easy for all project participants to recognize.
4. **Technical requirements.** More frequently than not, a product or service will have technical requirements to ensure proper performance. Technical requirements typically clarify either the deliverables or define the performance specifications. For example, a technical requirement for a personal computer might be the ability to accept 120-volt alternating current or 240-volt direct current without any adapters or user switches. Another well-known example is the ability of 911 emergency systems to identify the caller's phone number and location of the phone. Examples from information systems projects include speed and capacity of database systems and connectivity with alternative systems. For understanding the importance of key requirements, see Snapshot from Practice: Big Bertha.
5. **Limits and exclusions.** The limits of scope should be defined. Failure to do so can lead to false expectations and to expending resources and time on the wrong problem. Examples of limits are: local air transportation to and from base camps will be outsourced; system maintenance and repair will be done only up to one month after final inspection; client will be billed for additional training beyond that prescribed in the contract. Exclusions further define the boundary of the project by stating what is not included. Examples include: data will be collected by the client, not the contractor; a house will be built, but no landscaping or security devices added; software will be installed, but no training given.
6. **Reviews with customer.** Completion of the scope checklist ends with a review with your customer—internal or external. The main concern here is the understanding and agreement of expectations. Is the customer getting what he or she desires in deliverables? Does the project definition identify key accomplishments, budgets, timing, and performance requirements? Are questions of limits and exclusions covered? Clear communication in all these issues is imperative to avoid claims or misunderstanding.

Scope definition should be as brief as possible but complete; one or two pages are typical for small projects. See Snapshot from Practice: Scope Statement on page 105.

SNAPSHOT FROM PRACTICE

Big Bertha II versus the USGA's COR Requirement*

In 1991 Callaway Golf Equipment introduced their Big Bertha driver and revolutionized the golf equipment business. Big Bertha—named after the World War I German long-distance cannon—was much larger than conventional woods and lacked a hosel (the socket in the head of the club into which the shaft is inserted) so that the weight could be better distributed throughout the head. This innovative design gave the clubhead a larger sweet spot, which allowed a player to strike the golf ball off-center and not suffer much loss in distance or accuracy. Callaway has maintained its preeminent position in the golf industry by utilizing space-age technology to extend the accuracy and distance of golf equipment.

In 2000 Callaway introduced the Big Bertha ERC II forged titanium driver. The driver was technologically superior to any driver on the market. However, there was one big problem. The new version of Bertha did not conform to the coefficient of restitution (COR) requirement established by the United States Golf Association (USGA). As a result it was barred from use by golfers in North America who intended to play by USGA's Rules of Golf.

The USGA believed that the rapid technological advances in golf equipment made by Callaway Golf and other golf manufacturers were threatening the integrity of the game. Players were hitting balls so much farther and straighter that golf courses around the world were being redesigned to make them longer and more difficult.

So in 1998 the USGA established performance thresholds for all new golf equipment. In order to prevent manufacturers from developing more powerful clubs, the USGA limited the COR of new golf equipment to 0.83. The COR was calculated by firing a golf ball at a driver out of a cannon-like machine at 109 miles per hour. The speed that the ball returned to the cannon could not exceed 83 percent of its initial speed (90.47 mph). The USGA called the ratio of incoming to outgoing velocity the coefficient of restitution (COR). The intent of the USGA COR threshold was to limit the distance that golf balls could be hit since studies indicated that 0.01 increase in COR resulted in two extra yards of carry. The Big Bertha ERC II's COR was 0.86.

After numerous efforts to get USGA to change its technical requirements, Callaway's engineers went back to the drawing board and in 2002 introduced Great Big Bertha II, which conformed to USGA's 0.83 COR restriction.

* John E. Gamble. "Callaway Golf Company: Sustaining Advantage in a Changing Industry," in A. A. Thompson, J. E. Gamble, and A. J. Strickland, *Strategy: Winning in the Marketplace,* Boston: McGraw-Hill/Irwin, 2004, pp. C204–C228.

SNAPSHOT FROM PRACTICE Scope Statement

PROJECT OBJECTIVE

To construct a high-quality, custom home within five months at cost not to exceed $500,000.

DELIVERABLES

- A 2,200-square-foot, 2½-bath, 3-bedroom, finished home.
- A finished garage, insulated and sheetrocked.
- Kitchen appliances to include range, oven, microwave, and dishwasher.
- High-efficiency gas furnace with programmable thermostat.

MILESTONES

1. Permits approved—March 5
2. Foundation poured—March 14
3. Drywall in. Framing, sheathing, plumbing, electrical, and mechanical inspections passed—May 25
4. Final inspection—June 7

TECHNICAL REQUIREMENTS

1. Home must meet local building codes.
2. All windows and doors must pass NFRC class 40 energy ratings.
3. Exterior wall insulation must meet an "R" factor of 21.
4. Ceiling insulation must meet an "R" factor of 38.
5. Floor insulation must meet an "R" factor of 25.
6. Garage will accommodate two large-size cars and one 20-foot Winnebago.
7. Structure must pass seismic stability codes.

LIMITS AND EXCLUSIONS

1. The home will be built to the specifications and design of the original blueprints provided by the customer.
2. Owner is responsible for landscaping.
3. Refrigerator is not included among kitchen appliances.
4. Air conditioning is not included but prewiring is included.
5. Contractor reserves the right to contract out services.
6. Contractor is responsible for subcontracted work.
7. Site work limited to Monday through Friday, 8:00 A.M. to 6:00 P.M.

CUSTOMER REVIEW

John and Joan Smith

The checklist on pages 102–103 is generic. Different industries and companies will develop unique checklists and templates to fit their needs and specific kinds of projects. A few companies engaged in contracted work refer to scope statements as "statements of work" (SOW). Other organizations use the term *project charter.* However, the term **project charter** has emerged to have a special meaning in the world of project management. A project charter refers to a document that authorizes the project manager to initiate and lead the project. This document is issued by upper management and provides the project manager with written authority to use organizational resources for project activities. Often the charter will include a brief scope description as well as such items as risk limits, customer needs, spending limits, and even team composition.

Many projects suffer from **scope creep,** which is the tendency for the project scope to expand over time—usually by changing requirements, specifications, and priorities. Scope creep can be reduced by carefully writing your scope statement. A scope statement that is too broad is an invitation for scope creep. Scope creep can have a positive or negative effect on the project, but in most cases scope creep means added costs and possible project delays. Changes in requirements, specifications, and priorities frequently result in cost overruns and delays. Examples are abundant—Denver airport baggage handling system; Boston's new freeway system ("The Big Dig"); China's fast train in Shanghai; and the list goes on. On software development projects, scope creep is manifested in bloated products in which added functionality undermines ease of use.

If the project scope needs to change, it is critical to have a sound change control process in place that records the change and keeps a log of all project changes. The log identifies the change, impact, and those responsible for accepting or rejecting a proposed change.

Change control is one of the topics of Chapter 7. Project managers in the field constantly suggest that dealing with changing requirements is one of their most challenging problems.

Step 2: Establishing Project Priorities

Quality and the ultimate success of a project are traditionally defined as meeting and/or exceeding the expectations of the customer and/or upper management in terms of cost (budget), time (schedule), and performance (scope) of the project (see Figure 4.1). The interrelationship among these criteria varies. For example, sometimes it is necessary to compromise the performance and scope of the project to get the project done quickly or less expensively. Often the longer a project takes, the more expensive it becomes. However, a positive correlation between cost and schedule may not always be true. Other times project costs can be reduced by using cheaper, less efficient labor or equipment that extends the duration of the project. Likewise, as will be seen in Chapter 9, project managers are often forced to expedite or "crash" certain key activities by adding additional labor, thereby raising the original cost of the project.

One of the primary jobs of a project manager is to manage the trade-offs among time, cost, and performance. To do so, project managers must define and understand the nature of the priorities of the project. They need to have a candid discussion with the project customer and upper management to establish the relative importance of each criterion. For example, what happens when the customer keeps adding requirements? Or if, midway through the project, a trade-off must be made between cost and expediting, which criterion has priority?

One technique found in practice that is useful for this purpose is completing a **priority matrix** for the project to identify which criterion is constrained, which should be enhanced, and which can be accepted:

Constrain. The original parameter is fixed. The project must meet the completion date, specifications and scope of the project, or budget.

Enhance. Given the scope of the project, which criterion should be optimized? In the case of time and cost, this usually means taking advantage of opportunities to either reduce costs or shorten the schedule. Conversely, with regard to performance, enhancing means adding value to the project.

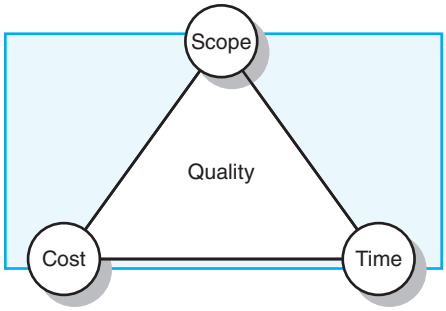
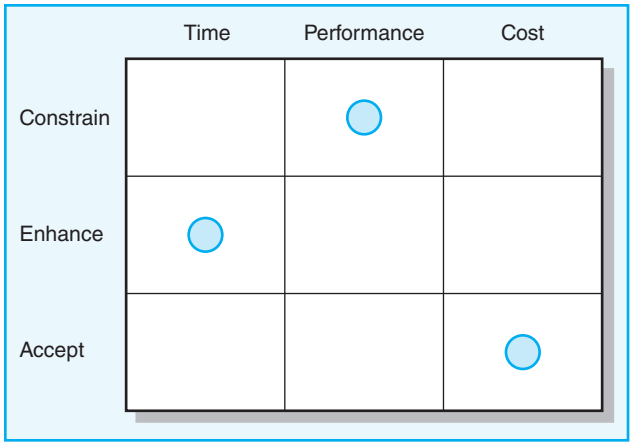


FIGURE 4.1
Project Management Trade-offs

FIGURE 4.2
Project Priority Matrix



Accept. For which criterion is it tolerable not to meet the original parameters? When trade-offs have to be made, is it permissible for the schedule to slip, to reduce the scope and performance of the project, or to go over budget?

Figure 4.2 displays the priority matrix for the development of a new wireless modem. Because *time* to market is important to sales, the project manager is instructed to take advantage of every opportunity to reduce completion time. In doing so, going over *budget* is acceptable though not desirable. At the same time, the original *performance* specifications for the modem as well as reliability standards cannot be compromised.

Priorities vary from project to project. For example, for many software projects time to market is critical, and companies like Microsoft may defer original scope requirements to later versions in order to get to the market first. Alternatively, for special event projects (conferences, parades, tournaments) time is constrained once the date has been announced, and if the budget is tight, the project manager will compromise the scope of the project in order to complete the project on time.

Some would argue that all three criteria are always constrained and that good project managers should seek to optimize each criterion. If everything goes well on a project and no major problems or setbacks are encountered, their argument may be valid. However, this situation is rare, and project managers are often forced to make tough decisions that benefit one criterion while compromising the other two. The purpose of this exercise is to define and agree on what the priorities and constraints of the project are so that when "push comes to shove," the right decisions can be made.

There are likely to be natural limits to the extent managers can constrain, optimize, or accept any one criterion. It may be acceptable for the project to slip one month behind schedule but no further or to exceed the planned budget by as much as $20,000. Likewise, it may be desirable to finish a project a month early, but after that cost conservation should be the primary goal. Some project managers document these limits as part of creating the priority matrix.

In summary, developing a priority matrix for a project *before the project begins* is a useful exercise. It provides a forum for clearly establishing priorities with customers and top management so as to create shared expectations and avoid misunderstandings. The priority information is essential to the planning process, where adjustments can be made in the scope, schedule, and budget allocation.

Finally, the matrix is useful midway in the project for approaching a problem that must be solved.

One caveat must be mentioned; during the course of a project, priorities may change. The customer may suddenly need the project completed one month sooner, or new directives from top management may emphasize cost saving initiatives. The project manager needs to be vigilant in order to anticipate and confirm changes in priorities and make appropriate adjustments.

Step 3: Creating the Work Breakdown Structure

Major Groupings Found in a WBS

Once the scope and deliverables have been identified, the work of the project can be successively subdivided into smaller and smaller work elements. The outcome of this hierarchical process is called the **work breakdown structure (WBS).** Use of WBS helps to assure project managers that all products and work elements are identified, to integrate the project with the current organization, and to establish a basis for control. Basically, the WBS is an outline of the project with different levels of detail.

Figure 4.3 shows the major groupings commonly used in the field to develop a hierarchical WBS. The WBS begins with the project as the final deliverable. Major

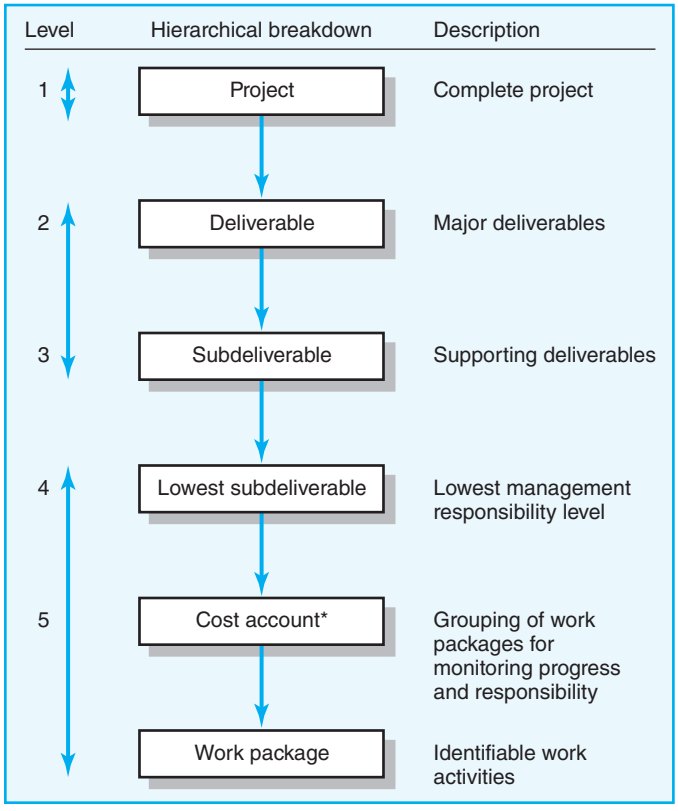


FIGURE 4.3
Hierarchical Breakdown of the WBS

* This breakdown groups work packages by type of work within a deliverable and allows assignment of responsibility to an organizational unit. This extra step facilitates a system for monitoring project progress (discussed in Chapter 13).

project work deliverables/systems are identified first; then the subdeliverables necessary to accomplish the larger deliverables are defined. The process is repeated until the subdeliverable detail is small enough to be manageable and where one person can be responsible. This subdeliverable is further divided into work packages. Because the lowest subdeliverable usually includes several work packages, the work packages are grouped by type of work—for example, design and testing. These groupings within a subdeliverable are called cost accounts. This grouping facilitates a system for monitoring project progress by work, cost, and responsibility.

How WBS Helps the Project Manager

The WBS defines all the elements of the project in a hierarchical framework and establishes their relationships to the project end item(s). Think of the project as a large work package that is successively broken down into smaller work packages; the total project is the summation of all the smaller work packages. This hierarchical structure facilitates evaluation of cost, time, and technical performance at all levels in the organization over the life of the project. The WBS also provides management with information appropriate to each level. For example, top management deals primarily with major deliverables, while first-line supervisors deal with smaller subdeliverables and work packages.

Each item in the WBS needs a time and cost estimate. With this information it is possible to plan, schedule, and budget your project. The WBS also serves as a framework for tracking cost and work performance.

As the WBS is developed, organizational units and individuals are assigned responsibility for executing work packages. This integrates the work and the organization. In practice, this process is sometimes called the organization breakdown structure (OBS), which will be further discussed later in the chapter.

Use of the WBS provides the opportunity to "roll up" (sum) the budget and actual costs of the smaller work packages into larger work elements so that performance can be measured by organizational units and work accomplishment.

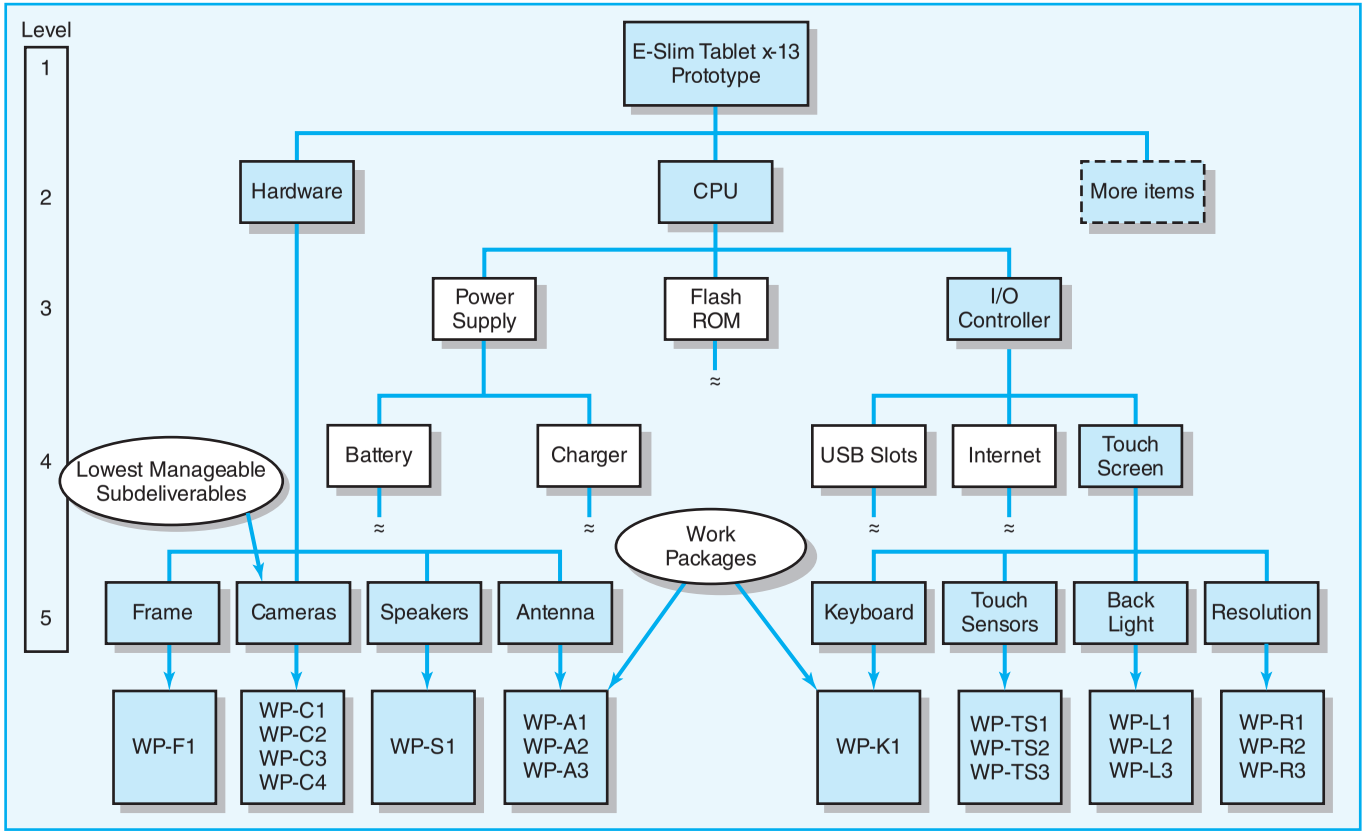
The WBS can also be used to define communication channels and assist in understanding and coordinating many parts of the project. The structure shows the work and organizational units responsible and suggests where written communication should be directed. Problems can be quickly addressed and coordinated because the structure integrates work and responsibility.

A Simple WBS Development

Figure 4.4 shows a simplified WBS to develop a new prototype tablet computer. At the top of the chart (level 1) is the project end item—the E-Slim Tablet x-13 Prototype. The subdeliverables levels (2–5) below level 1 represent further decomposition of work. The levels of the structure can also represent information for different levels of management. For example, level 1 information represents the total project objective and is useful to top management; levels 2, 3, and 4 are suitable for middle management; and level 5 is for first-line managers.

In Figure 4.4 level 2 indicates there are two major deliverables—Hardware and CPU, or central processing unit. (There are likely to be other major

FIGURE 4.4 Work Breakdown Structure



deliverables such as software, but for illustrative purposes we are limiting our focus to just two major deliverables.) At level 3, the CPU is connected to three deliverables—Power Supply, Flash ROM, and I/O Controller. The I/O Controller has three subdeliverables at level 4—USB Slots, Internet, and Touch Screen. The many subdeliverables for USB Slots and Internet have not been decomposed. The Touch Screen (shaded) has been decomposed down to level 5 and to the work package level.

Note that level 2, Hardware, skips levels 3 and 4 because the final subdeliverables can be pushed down to the lowest manageable level 5; skipping levels 3 and 4 suggests little coordination is needed and skilled team members are already familiar with the work needed to complete the level 5 subdeliverables. For example, Hardware requires four subdeliverables at level 5—Frame, Cameras, Speakers, and Antenna. Each subdeliverable includes work packages that will be completed by an assigned organizational unit. Observe that the Cameras subdeliverable includes four work packages—WP-C1, 2, 3, and 4. The Back Light, a subdeliverable of Touch Screen, includes three work packages—WP-L 1, 2, and 3.

The lowest level of the WBS is called a **work package.** Work packages are short-duration tasks that have a definite start and stop point, consume resources, and represent cost. Each work package is a control point. A work package manager is responsible for seeing that the package is completed on time, within budget, and according to technical specifications. Practice suggests a work package should not exceed 10 workdays or one reporting period. If a work package has a duration exceeding 10 days, check or monitoring points should be established within the duration, say, every three to five days, so progress and problems can be identified before too much time has passed. Each work package of the WBS should be as independent of other packages of the project as possible. No work package is described in more than one subdeliverable of the WBS.

There is an important difference from start to finish between the last work breakdown subdeliverable and a work package. Typically, a work breakdown subdeliverable includes the outcomes of more than one work package from perhaps two or three departments. Therefore, the subdeliverable does not have a duration of its own and does not consume resources or cost money directly. (In a sense, of course, a duration for a particular work breakdown element can be derived from identifying which work package must start first [earliest] and which package will be the latest to finish; the difference from start to finish becomes the duration for the subdeliverable.) The higher elements are used to identify deliverables at different phases in the project and to develop status reports during the execution stage of the project life cycle. Thus, the work package is the basic unit used for planning, scheduling, and controlling the project.

To review, each work package in the WBS

1. Defines work (what).
2. Identifies time to complete a work package (how long).
3. Identifies a time-phased budget to complete a work package (cost).
4. Identifies resources needed to complete a work package (how much).
5. Identifies a single person responsible for units of work (who).
6. Identifies monitoring points for measuring progress (how well).

Creating a WBS from scratch can be a daunting task. Project managers should take advantage of relevant examples from previous projects to begin the process.

SNAPSHOT FROM PRACTICE Creating a WBS

Figure 4.4 represents the classic WBS in which the project is broken down to the lowest manageable deliverable and subsequent work packages. Many situations do not require this level of detail. This begs the questions of how far you should break down the work.

There is no set answer to this question. However, here are some tips given by project managers:

Break down the work until you can do an estimate that is accurate enough for your purposes. If you are doing a ball-park estimate to see if the project is worthy of serious consideration, you probably do not need to break it down beyond major deliverables. On the other hand, if you are pricing a project to submit a competitive bid, then you are likely to go down to the work package level.

The WBS should conform to how you are going to schedule work. For example, if assignments are made in terms of days, then tasks should be limited as best as possible to one day or more to complete. Conversely, if hours are the smallest unit for scheduling, then work can be broken down to one-hour increments.

Final activities should have clearly defined start/end events. Avoid open-ended tasks like "research" or "market analysis." Take it down to the next level in which deliverables/outcomes are more clearly defined. Instead of ending with market analysis include items such as identify market share, list user requirements, or write a problem statement.

If accountability and control are important, then break the work down so that one individual is clearly responsible for the work. For example, instead of stopping at product design, take it to the next level and identify specific components of the design (i.e., electrical schematics, power source, etc.) that different individuals will be responsible for creating.

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The bottom line is that the WBS should provide the level of detail needed to manage the specific project successfully.

WBSs are products of group efforts. If the project is small, the entire project team may be involved breaking down the project into its components. For large, complex projects, the people responsible for the major deliverables are likely to meet to establish the first two levels of deliverables. In turn, further detail would be delegated to the people responsible for the specific work. Collectively this information would be gathered and integrated into a formal WBS by a project support person. The final version would be reviewed by the inner echelon of the project team. Relevant stakeholders (most notably customers) would be consulted to confirm agreement and revise when appropriate.

Project teams developing their first WBS frequently forget that the structure should be end-item, output oriented. First attempts often result in a WBS that follows the organization structure—design, marketing, production, finance. If a WBS follows the organization structure, the focus will be on the organization function and processes rather than the project output or deliverables. In addition, a WBS with a process focus will become an accounting tool that records costs by function rather than a tool for "output" management. Every effort should be made to develop a WBS that is output oriented in order to concentrate on concrete deliverables. See Snapshot from Practice: Creating a WBS.

Step 4: Integrating the WBS with the Organization

The WBS is used to link the organizational units responsible for performing the work. In practice, the outcome of this process is the **organization breakdown structure (OBS).** The OBS depicts how the firm has organized to discharge work responsibility. The purposes of the OBS are to provide a framework to summarize organization unit work performance, identify organization units responsible for work packages, and tie the organizational unit to cost control accounts. Recall, cost accounts group similar work packages (usually under the purview of a department). The OBS defines the organization subdeliverables in a hierarchical pattern in successively smaller and smaller units. Frequently, the traditional organization structure can be used. Even if the project is completely performed by a team, it is necessary to break down the team structure for assigning responsibility for budgets, time, and technical performance.

As in the WBS, the OBS assigns the lowest organizational unit the responsibility for work packages within a cost account. Herein lies one major strength of using WBS and OBS; they can be *integrated* as shown in Figure 4.5. The intersection of work packages and the organizational unit creates a project control point **(cost account)** that integrates work and responsibility. For example, at level 5 Touch Sensors has three work packages that have been assigned to the Design, Quality Control Test, and Production departments. The intersection of the WBS and OBS represents the set of work packages necessary to complete the subdeliverable located immediately above and the organizational unit on the left responsible for accomplishing the packages at the intersection. Note that the design department is responsible for five different work packages across the Hardware and Touch Screen deliverables.

Later we will use the intersection as a cost account for management control of projects. For example, the Cameras element requires completion of work packages whose primary responsibility will include the design, QC test, production, and outsourcing departments. Control can be checked from two directions—outcomes and responsibility. In the execution phase of the project, progress can be tracked vertically on deliverables (client's interest) and tracked horizontally by organization responsibility (owner's interest).

Step 5: Coding the WBS for the Information System

Gaining the maximum usefulness of a breakdown structure depends on a coding system. The codes are used to define levels and elements in the WBS, organization elements, work packages, and budget and cost information. The codes allow reports to be consolidated at any level in the structure. The most commonly used scheme in practice is numeric indention. A portion of the E-Slim Tablet x-13 Prototype project is presented in Exhibit 4.1.

Note the project identification is 1.0. Each successive indention represents a lower element or work package. Ultimately the numeric scheme reaches down to the work package level, and all tasks and elements in the structure have an identification code. The "cost account" is the focal point because all budgets,

FIGURE 4.5 Integration of WBS and OBS

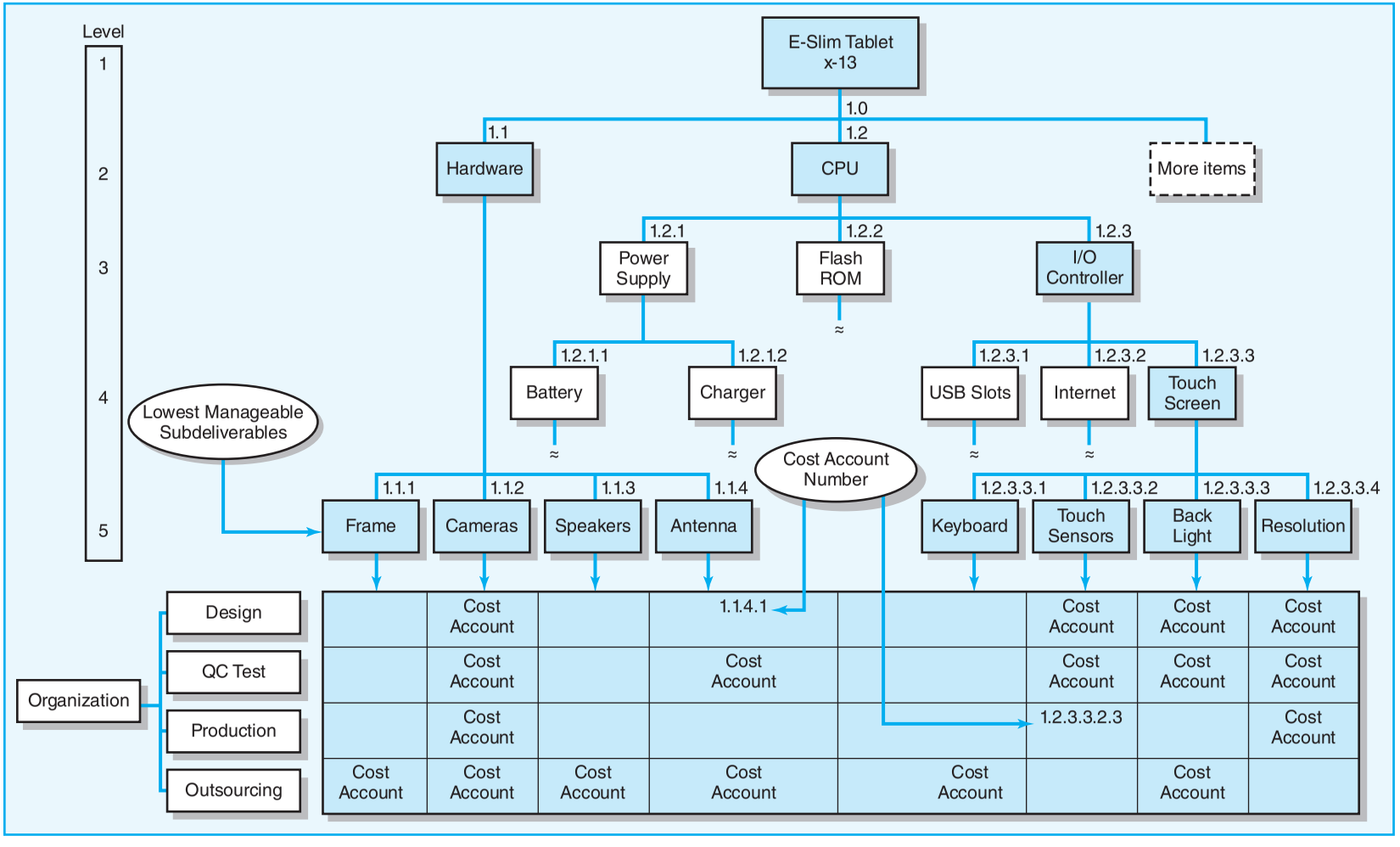


EXHIBIT 4.1
Coding the WBS

	Task Mode	Task Name
1		**1 E-Slim Tablet x-13 Prototype**
2		**1.1 Hardware**
3		1.1.1 Cameras
4		1.1.2 Speakers
5		1.1.3 Antenna
6		**1.2 CPU**
7		**1.2.1 Power supply**
8		1.2.1.1 Battery (more items)
9		1.2.1.2 Charger (more items)
10		**1.2.2 Flash Rom (more items)**
11		1.2.2.1 I/O controller
12		1.2.2.2 USB slots (more items)
13		1.2.2.3 Internet (more items)
14		**1.2.3 Touch screen**
15		**1.2.3.1 Keyboard**
16		1.2.3.1.1 Work package
17		**1.2.3.2 Touch sensors**
18		1.2.3.2.1 Work package
19		1.2.3.2.2 Work package
20		1.2.3.2.3 Work package
21		1.2.3.3 Back light (more items)
22		1.2.3.4 Resolution (more items)

work assignments, time, cost, and technical performance come together at this point.

This coding system can be extended to cover large projects. Additional schemes can be added for special reports. For example, adding a "23" after the code could indicate a site location, an elevation, or a special account such as labor. Some letters can be used as special identifiers such as "M" for materials or "E" for engineers. You are not limited to only 10 subdivisions (0–9); you can extend each subdivision to large numbers—for example, .1−.99 or .1−.9999. If the project is small, you can use whole numbers. The following example is from a large, complex project:

$$3R-237A-P2-33.6$$

where 3R identifies the facility, 237A represents elevation and the area, P2 represents pipe two inches wide, and 33.6 represents the work package number. In practice most organizations are creative in combining letters and numbers to minimize the length of WBS codes.

On larger projects, the WBS is further supported with a **WBS dictionary** that provides detailed information about each element in the WBS. The dictionary typically includes the work package level (code), name, and functional description. In some cases the description is supported with specifications. The availability of detailed descriptions has an added benefit of dampening scope creep.

Process Breakdown Structure

The WBS is best suited for design and build projects that have tangible outcomes such as an offshore mining facility or a new car prototype. The project can be decomposed or broken down into major deliverables, subdeliverables, further subdeliverables, and ultimately to work packages. It is more difficult to apply WBS to less tangible, *process-oriented* projects in which the final outcome is a product of a series of steps or phases. Here, the big difference is that the project evolves over time with each phase affecting the next phase. Information systems projects typically fall in this category—for example, creating an extranet website or an internal software database system. Process projects are driven by performance requirements, not by plans/blueprints. Some practitioners choose to utilize what we refer to as a **process breakdown structure (PBS)** instead of the classic WBS.

Figure 4.6 provides an example of a PBS for a software development project. Instead of being organized around deliverables, the project is organized around phases. Each of the five major phases can be broken down into more specific activities until a sufficient level of detail is achieved to communicate what needs to be done to complete that phase. People can be assigned to specific activities, and a complementary OBS can be created just as is done for the WBS. Deliverables are not ignored but are defined as outputs required to move to the next phase. The software industry often refers to PBS as the "waterfall method" since progress flows downward through each phase.[1]

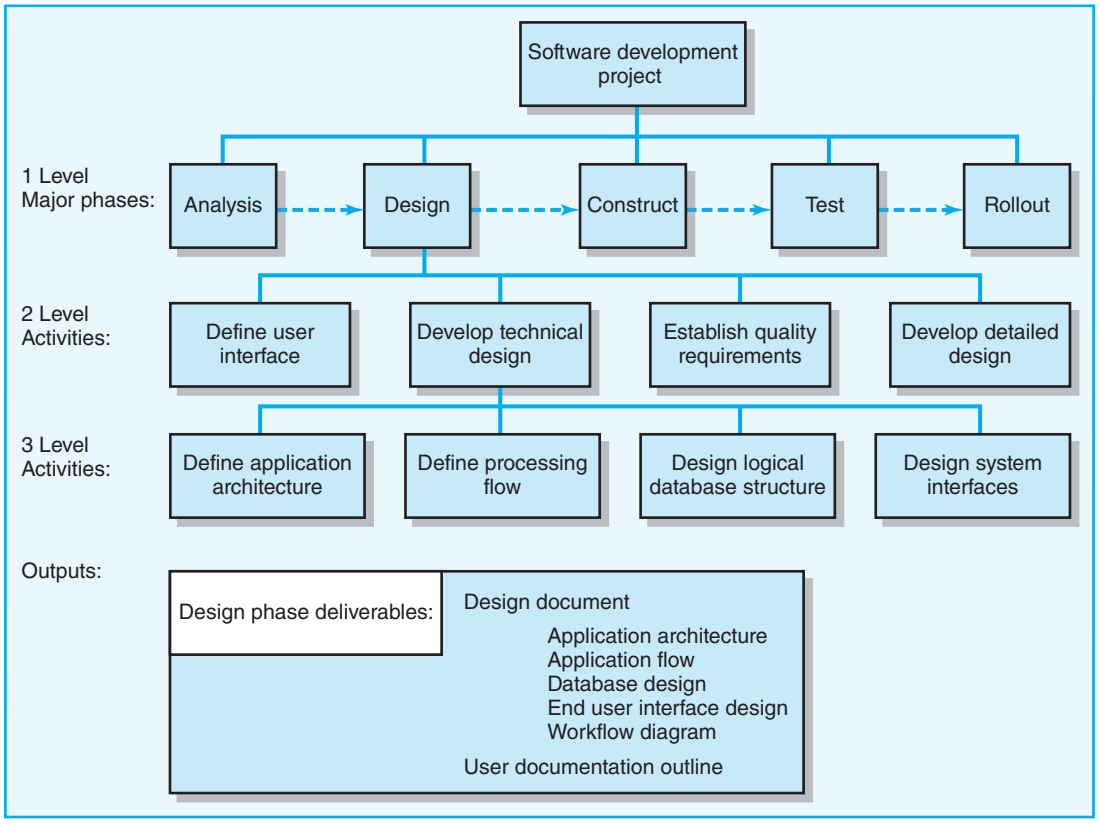
Checklists that contain the phase exit requirements are developed to manage project progress. These checklists provide the means to support phase walk-throughs and reviews. Checklists vary depending upon the project and activities involved but typically include the following details:

- Deliverables needed to exit a phase and begin a new one.
- Quality checkpoints to ensure that deliverables are complete and accurate.
- Sign-offs by all responsible stakeholders to indicate that the phase has been successfully completed and that the project should move on to the next phase.

As long as exit requirements are firmly established and deliverables for each phase are well defined, the PBS provides a suitable alternative to the standard WBS for projects that involve extensive development work.

[1] The limitations of the waterfall method for software development have led to the emergence of Agile project management methods that are the subject of Chapter 17.

FIGURE 4.6 **PBS for Software Development Project**



Responsibility Matrices

In many cases, the size and scope of the project do not warrant an elaborate WBS or OBS. One tool that is widely used by project managers and task force leaders of small projects is the **responsibility matrix** (RM). The RM (sometimes called a linear responsibility chart) summarizes the tasks to be accomplished and who is responsible for what on a project. In its simplest form an RM consists of a chart listing all the project activities and the participants responsible for each activity. For example, Figure 4.7 illustrates an RM for a market research study. In this matrix the R is used to identify the committee member who is responsible for coordinating the efforts of other team members assigned to the task and making sure that the task is completed. The S is used to identify members of the five-person team who will support and/or assist the individual responsible. Simple RMs like this one are useful not only for organizing and assigning responsibilities for small projects but also for subprojects of large, more complex projects.

More complex RMs not only identify individual responsibilities but also clarify critical interfaces between units and individuals that require coordination. For

FIGURE 4.7 Responsibility Matrix for a Market Research Project

	Project Team				
Task	Richard	Dan	Dave	Linda	Elizabeth
Identify target customers	R	S		S	
Develop draft questionnaire	R	S	S		
Pilot-test questionnaire		R		S	
Finalize questionnaire	R	S	S	S	
Print questionnaire					R
Prepare mailing labels					R
Mail questionnaires					R
Receive and monitor returned questionnaires				R	S
Input response data			R		
Analyze results		R	S	S	
Prepare draft of report	S	R	S	S	
Prepare final report	R		S		

R = Responsible
S = Supports/assists

example, Figure 4.8 is an RM for a larger, more complex project to develop a new piece of automated equipment. Notice that within each cell a numeric coding scheme is used to define the nature of involvement on that specific task. Such an RM extends the WBS/OBS and provides a clear and concise method for depicting responsibility, authority, and communication channels.

Responsibility matrices provide a means for all participants in a project to view their responsibilities and agree on their assignments. They also help clarify the extent or type of authority exercised by each participant in performing an activity in which two or more parties have overlapping involvement. By using an RM and by defining authority, responsibility, and communications within its framework, the relationship between different organizational units and the work content of the project is made clear.

Project Communication Plan

Once the project deliverables and work are clearly identified, following up with an internal communication plan is vital. Stories abound of poor communication as a major contributor to project failure. Having a robust communications plan can go a long way toward mitigating project problems and can ensure that customers, team members, and other stakeholders have the information to do their jobs.

The communication plan is usually created by the project manager and/or the project team in the early stage of project planning.

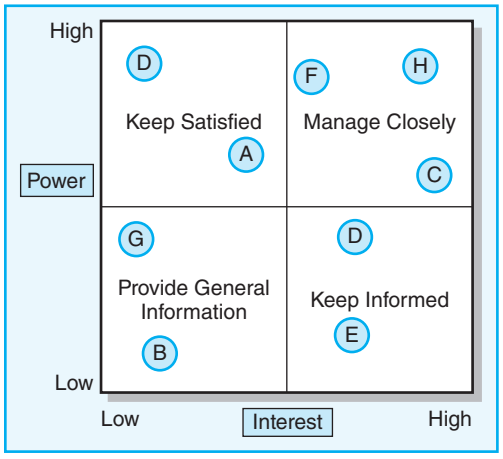
Communication is a key component in coordinating and tracking project schedules, issues, and action items. The plan maps out the flow of information to

FIGURE 4.8 **Responsibility Matrix for the Conveyor Belt Project**

	Organization							
Deliverables	Design	Development	Documentation	Assembly	Testing	Purchasing	Quality Assur.	Manufacturing
Architectural designs	1	2			2		3	3
Hardware specifications	2	1				2	3	
Kernel specifications	1	3						3
Utilities specifications	2	1			3			
Hardware design	1			3		3		3
Disk drivers	3	1	2					
Memory management	1	3			3			
Operating system documentation	2	2	1					3
Prototypes	5		4	1	3	3	3	4
Integrated acceptance test	5	2	2		1		5	5

1 Responsible
2 Support
3 Consult
4 Notification
5 Approval

FIGURE 4.9
Stakeholder Communications



different stakeholders and becomes an integral part of the overall project plan. The purpose of a project communication plan is to express what, who, how, and when information will be transmitted to project stakeholders so schedules, issues, and action items can be tracked.

Project communication plans address the following core questions:

- What information needs to be collected and when?
- Who will receive the information?
- What methods will be used to gather and store information?
- What are the limits, if any, on who has access to certain kinds of information?
- When will the information be communicated?
- How will it be communicated?

Developing a communication plan that answers these questions usually entails the following basic steps:

1. **Stakeholder analysis.** Identify the target groups. Typical groups could be the customer, sponsor, project team, project office, or anyone who needs project information to make decisions and/or contribute to project progress. A common tool found in practice to initially identify and analyze major project stakeholders' communication needs is presented in Figure 4.9.[2] How and what is communicated is influenced by the stakeholder interest and power. Some of these stakeholders may have the power either to block or enhance your project. By identifying stakeholders and prioritizing them on the "Power/Interest" map, you can plan the type and frequency of communications needed. (More on stakeholders will be discussed in Chapter 10.)

   For example, on a typical project you want to manage closely the professionals doing the work, while you want to satisfy senior management and project

[2] For a more elaborate scheme for assessing stakeholders, see: Lynda Bourne, *Stakeholder Relationship Management* (Farnham, U.K.: Gower Publishing Ltd., 2009).

sponsor with periodic updates. Unions and operation managers interested in capacity would be someone you would want to keep informed, while you would only need to provide general information to the legal, public relations, and other departments.

2. **Information needs.** What information is pertinent to stakeholders who contribute to the project's progress? The simplest answer to this question can be obtained by asking the different people what information they need and when they need it. For example, top management needs to know how the project is progressing, whether it is encountering critical problems, and the extent to which project goals are being realized. This information is required so that they can make strategic decisions and manage the portfolio of projects. Project team members need to see schedules, task lists, specifications, and the like, so they know what needs to be done next. External groups need to know any changes in the schedule and performance requirements of the components they are providing. Frequent information needs found in communication plans are:

Project status reports	Deliverable issues
Changes in scope	Team status meetings
Gating decisions	Accepted request changes
Action items	Milestone reports

3. **Sources of information.** When the information needs are identified, the next step is to determine the sources of information. That is, where does the information reside? How will it be collected? For example, information relating to the milestone report, team meetings, and project status meetings would be found in the minutes and reports of various groups.
4. **Dissemination modes.** In today's world, traditional status report meetings are being supplemented by e-mail, teleconferencing, SharePoint, and a variety of database sharing programs to circulate information. In particular, many companies are using the Web to create a "virtual project office" to store project information. Project management software feeds information directly to the Web site so that different people have immediate access to relevant project information. In some cases, appropriate information is routed automatically to key stakeholders. Backup paper hardcopy to specific stakeholders is still critical for many project changes and action items.
5. **Responsibility and timing.** Determine who will send out the information. For example, a common practice is to have secretaries of meetings forward the minutes or specific information to the appropriate stakeholders. In some cases the responsibility lies with the project manager or project office. Timing and frequency of distribution appropriate to the information need to be established.

The advantage of establishing a communication plan is that instead of responding to information requests, you are controlling the flow of information. This reduces confusion and unnecessary interruptions, and it can provide project managers greater autonomy. Why? By reporting on a regular basis how things are going and what is happening, you allow senior management to feel more comfortable about letting the team complete the project without interference. See Figure 4.10 for a sample Shale Oil Research Project Communication Plan.

FIGURE 4.10 **Shale Oil Research Project Communication Plan**

What Information	*Target Audience*	*When?*	*Method of Communication*	*Provider*
Milestone report	Senior management and project manager	Bimonthly	E-mail and hardcopy	Project office
Project status reports & agendas	Staff and customer	Weekly	E-mail and hardcopy	Project manager
Team status reports	Project manager and project office	Weekly	E-mail	Team recorder
Issues report	Staff and customer	Weekly	E-mail	Team recorder
Escalation reports	Staff and customer	When needed	Meeting and hardcopy	Project manager
Outsourcing performance	Staff and customer	Bimonthly	Meeting	Project manager
Accepted change requests	Project office, senior mgmt., customer, staff, and project mgr.	Anytime	E-mail and hardcopy	Design department
Oversight gate decisions	Senior management and project manager	As required	E-mail meeting report	Oversight group or project office

The importance of establishing up-front a plan for communicating important project information cannot be overstated. Many of the problems that plague a project can be traced back to insufficient time devoted to establishing a well-grounded internal communication plan.

Summary

The project scope definition, priorities, and breakdown structure are the keys to nearly every aspect of managing the project. The scope definition provides focus and emphasis on the end item(s) of the project. Establishing project priorities allows managers to make appropriate trade-off decisions. The structure helps ensure all tasks of the project are identified and provides two views of the project—one on deliverables and one on organization responsibility. The WBS avoids having the project driven by organization function or by a finance system. The structure forces attention to realistic requirements of personnel, hardware, and budgets. Use of the structure provides a powerful framework for project control that identifies deviations from plan, identifies responsibility, and spots areas for improved performance. No well-developed project plan or control system is possible without a disciplined, structured approach. The WBS, OBS, and cost account codes provide this discipline. The WBS will serve as the database for developing the project network which establishes the timing of work, people, equipment, and costs.

PBS is often used for process-based projects with ill-defined deliverables. In small projects responsibility matrices may be used to clarify individual responsibility.

Clearly defining your project is the first and most important step in planning. The absence of a clearly defined project plan consistently shows up as the major reason for project failures. Whether you use a WBS, PBS, or responsibility matrix will depend primarily on the size and nature of your project. Whatever method you use, definition of your project should be adequate to allow for good control as the project is being implemented. Follow-up with a clear communication plan for coordinating and tracking project progress will help keep important stakeholders informed and avoid some potential problems.

Key Terms

Cost account, *113*
Milestone, *103*
Organization breakdown structure (OBS), *113*
Priority matrix, *106*
Process breakdown structure (PBS), *116*
Project charter, *105*
Responsibility matrix, *117*
Scope creep, *105*
Scope statement, *105*
WBS dictionary, *116*
Work breakdown structure (WBS), *108*
Work package, *111*

Review Questions

1. What are the six elements of a typical scope statement?
2. What questions does a project objective answer? What would be an example of a good project objective?
3. What does it mean if the priorities of a project include: Time-constrain, Scope-accept, and Cost-enhance?
4. What kinds of information are included in a work package?
5. When would it be appropriate to create a responsibility matrix rather than a full-blown WBS?
6. How does a communication plan benefit management of projects?

Exercises

1. You are in charge of organizing a dinner-dance concert for a local charity. You have reserved a hall that will seat 30 couples and have hired a jazz combo.
   a. Develop a scope statement for this project that contains examples of all the elements. Assume that the event will occur in 4 weeks and provide your best guess estimate of the dates for milestones.
   b. What would the priorities likely be for this project?
2. In small groups, identify real life examples of a project that would fit each of the following priority scenarios:
   a. Time-constrain, Scope-enhance, Cost-accept
   b. Time-accept, Scope-constrain, Cost-accept
   c. Time-constrain, Scope-accept, Cost-enhance
3. Develop a WBS for a project in which you are going to build a bicycle. Try to identify all of the major components and provide three levels of detail.
4. You are the father or mother of a family of four (kids ages 13 and 15) planning a weekend camping trip. Develop a responsibility matrix for the work that needs to be done prior to starting your trip.

5. Develop a WBS for a local stage play. Be sure to identify the deliverables and organizational units (people) responsible. How would you code your system? Give an example of the work packages in one of your cost accounts. Develop a corresponding OBS which identifies who is responsible for what.
6. Use an example of a project you are familiar with or are interested in. Identify the deliverables and organizational units (people) responsible. How would you code your system? Give an example of the work packages in one of your cost accounts.
7. Develop a communication plan for an airport security project. The project entails installing the hardware and software system that (1) scans a passenger's eyes, (2) fingerprints the passenger, and (3) transmits the information to a central location for evaluation.
8. Go to an Internet search engine (e.g., Google) and type in "project communication plan." Check three or four that have ".gov" as their source. How are they similar or dissimilar? What would be your conclusion concerning the importance of an internal communication plan?
9. Your roommate is about to submit a scope statement for a spring concert sponsored by the entertainment council at Western Evergreen State University (WESU). WESU is a residential university with over 22,000 students. This will be the first time in six years since WESU sponsored a spring concert. The entertainment council has budgeted $40,000 for the project. The event is to occur on June 5th. Since your roommate knows you are taking a class on project management she has asked you to review her scope statement and make suggestions for improvement. She considers the concert a resume-building experience and wants to be as professional as possible. Below is a draft of her scope statement. What suggestions would you make and why?

WESU Spring Music Concert

Project Objective

To organize and deliver a 6-hour music concert

Deliverables

- Concert security
- Contact local newspapers and radio stations
- Separate beer garden
- Six hours of musical entertainment
- Design a commemorative concert t-shirt
- Local sponsors
- Food venues
- Event insurance
- Safe environment

Milestones

1. Secure all permissions and approvals
2. Sign big-name artist
3. Contact secondary artists
4. Secure vendor contracts
5. Advertising campaign
6. Plan set-up
7. Concert
8. Clean-up

Technical Requirements

1. Professional sound stage and system
2. At least five performing acts
3. Restroom facilities
4. Parking
5. Compliance with WESU and city requirements/ordinances

Limits and Exclusions

- Seating capacity for 8,000 students.
- Performers are responsible for travel arrangement to and from WESU.
- Performers must provide own liability insurance.
- Performers and security personnel will be provided lunch and dinner on the day of the concert.
- Vendors contribute 25 percent of sales to concert fund.
- Concert must be over at 12:15 A.M.

Customer Review: WESU

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Case

Manchester United Soccer Club

Nicolette Larson was loading the dishwasher with her husband, Kevin, and telling him about the first meeting of the Manchester United Tournament Organizing Committee. Nicolette, a self-confessed "soccer mom," had been elected tournament director and was responsible for organizing the club's first summer tournament.

Manchester United Soccer Club (MUSC) located in Manchester, New Hampshire, was formed in 1992 as a way of bringing recreational players to a higher level of competition and preparing them for the State Olympic Development Program and/or high school teams. The club currently has 24 boys and girls (ranging in age from under 9 to 16) on teams affiliated with the Hampshire Soccer Association and the Granite State Girls Soccer League. The club's board of directors decided in the fall to sponsor a summer invitational soccer tournament to generate revenue. Given the boom in youth soccer, hosting summer tournaments has become a popular method for raising funds. MUSC teams regularly compete in three to four tournaments each summer at different locales in New England. These tournaments have been reported to generate between $50,000 and $70,000 for the host club.

MUSC needs additional revenue to refurbish and expand the number of soccer fields at the Rock Rimmon soccer complex. Funds would also be used to augment the club's scholarship program, which provides financial aid to players who cannot afford the $450 annual club dues.

Nicolette gave her husband a blow-by-blow account of what transpired during the first tournament committee meeting that night. She started the meeting by having everyone introduce themselves and by proclaiming how excited she was that the club was going to sponsor its own tournament. She then suggested that the committee brainstorm what needed to be done to pull off the event; she would record their ideas on a flipchart.

What emerged was a free-for-all of ideas and suggestions. One member immediately stressed the importance of having qualified referees and spent several minutes describing in detail how his son's team was robbed in a poorly officiated championship game. This was followed by other stories of injustice on the soccer field. Another member suggested that they needed to quickly contact the local colleges to see if they could use their fields. The committee spent more than 30 minutes talking about how they should screen teams and how much they should charge as an entry fee. An argument broke out over whether they should reward the winning teams in each age bracket with medals or trophies. Many members felt that medals were too cheap, while others thought the trophies would be too expensive. Someone suggested that they seek local corporate sponsors to help fund the tournament. The proposed sale of tournament T-shirts and sweatshirts was followed by a general critique of the different shirts parents had acquired at different tournaments. One member advocated that they recruit an artist he knew to develop a unique silk-screen design for the tournament. The meeting adjourned 30 minutes late with only half of the members remaining until the end. Nicolette drove home with seven sheets of ideas and a headache.

As Kevin poured a glass of water for the two aspirin Nicolette was about to take, he tried to comfort her by saying that organizing this tournament would be a big project not unlike the projects he works on at his engineering and design firm. He offered to sit down with her the next night and help her plan the project. He suggested that the first thing they needed to do was to develop a WBS for the project.

1. Make a list of the major deliverables for the project and use them to develop a draft of the work breakdown structure for the tournament that contains at least three levels of detail. What are the major deliverables associated with hosting an event such as a soccer tournament?
2. How would developing a WBS alleviate some of the problems that occurred during the first meeting and help Nicolette organize and plan the project?
3. Where can Nicolette find additional information to help her develop a WBS for the tournament?
4. How could Nicolette and her task force use the WBS to generate cost estimates for the tournament? Why would this be useful information?